

EXHIBIT B

Rule 16 Summary of Expert Opinions, Bases, and Reasons

Case: United States v. Hubei Amarvel Biotech Co., Ltd.

Report date: November 14, 2024

Prepared by: Christine A. Herdman, Ph.D.

1. I am employed by the U.S. Department of Justice, Drug Enforcement Administration (DEA), as a Chemist.
2. The following is a complete statement of the expert opinions that I will offer, either in the Government's case-in-chief or during its rebuttal case to counter testimony that the defendant intends to offer, along with the bases and reasons for them. I reserve the right to supplement this notice with additional testimony to counter testimony that the defendant intends to offer following the disclosure of any expert testimony by the defendant pursuant to Federal Rule of Criminal Procedure 16(b)(1)(C).
3. My opinions and qualifications are based on my knowledge, skill, experience, training, and education, as set forth in my attached Curriculum Vitae. Any publications I have authored in the last ten years and any cases in which I have testified in the last four years as an expert, by trial or by deposition, are also listed in my Curriculum Vitae.
4. I expect to offer the following expert opinions:
 - a. Fentanyl and methamphetamine are synthetic drugs. I may present visual diagrams of their chemical structures.
 - b. Synthetic drugs can be manufactured using precursor chemicals. Precursor chemicals are substances, often identified by Chemical Abstracts Service ("CAS") number, that may not necessarily themselves be drugs, but can be chemically combined or converted to manufacture certain drugs.

- c. I will discuss the use of the precursors identified in the indictment to manufacture the synthetic drugs listed in the indictment, including the use of methylamine¹ to manufacture methamphetamine, and the use of N-boc-4-anilinopiperidine² and 1-boc-4-piperidone³ to manufacture fentanyl. I may present visual diagrams of these chemical structures.
- d. I will discuss the contents of the graphic at the top of page 14 of the indictment; specifically, that certain “Main Raw Material” and “Auxiliary Raw Materials” in the first four rows could serve as precursors for their corresponding “Final product.”
- e. I will discuss the contents of the graphic at the top of page 15 of the indictment; specifically, that the substances listed under the column “Name” are precursors for fentanyl.
- f. In the chemistry context, an analogue is a chemical compound that is similar in chemical structure to another chemical compound.
- g. ortho-Methyl-N-boc-4-anilinopiperidine⁴ is substantially similar in chemical structure to N-boc-4-anilinopiperidine. I may present visual diagrams of their chemical structures.
- h. ortho-Methyl-N-boc-4-anilinopiperidine is a precursor chemical for ortho-methylfentanyl.

¹ This substance bears the CAS registry number 74-89-5.

² This substance bears the CAS registry number 125541-22-2 and is also known as 1-boc-4-AP; 1-N-boc-4-(phenylamino)piperidine; and tert-butyl 4-(phenylamino)piperidine-1-carboxylate, among other labels.

³ This substance bears the CAS registry number 79099-07-3 and is also known as N-(tert-butoxycarbonyl)-4-piperidone, among other labels.

⁴ This substance bears the CAS registry number 1154101-90-2 and is also known as tert-butyl 4-((2-methylphenyl)amino)piperidine-1-carboxylate, among other labels.

- i. ortho-Methyl-N-boc-4-anilinopiperidine, in combination with propionyl chloride⁵ and (2-bromoethyl)benzene,⁶ can be used to manufacture ortho-methylfentanyl. I may present visual diagrams of these chemical structures.
 - j. ortho-Methylfentanyl is substantially similar in chemical structure to fentanyl. I may present visual diagrams of their chemical structures.
 - k. ortho-Methylfentanyl is defined as a fentanyl-related substance, as it is structurally related to fentanyl by the replacement of the aniline ring with any aromatic monocycle whether or not further substituted in or on the aromatic monocycle; specifically, the ortho-tolyl portion of the ortho-methylfentanyl is the extra group that differentiates it from the aniline ring.
5. I may also offer additional opinions in response to questions posed by the defense during trial.

CHRISTINE
HERDMAN

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CHRISTINE HERDMAN
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Christine A. Herdman, Ph.D.

⁵ This substance bears the CAS registry number 79-03-8 and is also known as propanoyl chloride, among other labels.

⁶ This substance bears the CAS registry number 103-63-9 and is also known as 2-phenethyl bromide, among other labels.

Christine A. Herdman, Ph.D.

United States Department of Justice
Drug Enforcement Administration

571-385-5275

Christine.a.herdman@dea.gov

EDUCATION

Ph.D., Organic Chemistry

August 2016

Baylor University: Waco, TX

Organic synthesis; drug design and synthesis; medicinal chemistry

B.S., Chemistry

May 2008

Saint Mary's College: Notre Dame, IN

EMPLOYMENT

Chemist

November 2019-present

Drug Enforcement Administration (DEA); Arlington, VA

Regulation of drugs of abuse; synthetic methodologies

Chemist – DEA Contractor

April 2018-November 2019

Drug Enforcement Administration (DEA); Arlington, VA

Contracted through Cherokee Business Nations

Regulation of drugs of abuse; analyze synthetic methodologies

Post-Doctoral Fellow

October 2016-April 2018

National Institutes of Health; Rockville, MD

Organic synthesis; synthesis of enantiopure compounds

Research Assistant

January 2013-August 2016

Baylor University; Waco, TX

Research Assistant Spring 2013, Spring 2014, Fall 2014-Summer 2016

Teaching Assistant

August 2010-December 2013

Baylor University; Waco, TX

Lab Tech - Chemist

July 2008- July 2010

Walter Reed Army Institute of Research (WRAIR); Silver Spring, MD

Organic synthesis; acetylcholinesterase reactivators

PUBLICATIONS

"The intriguing effects of substituents in the N-phenethyl moiety of norhydromorphone: a bifunction opioid from a set of "tail wags dog" experiments." M. Wang, T.C. Ivrin, **C.A. Herdman**, R.D. Hanna, S.A. Hassan, Y.S. Lee, S. Kaska, R.S. Crowley, R.Saylor, T. E. Prisinzano, S.L. Withey, C.A. Paronis, J. Bergman, S. Inan, E.B. Geller, M.W. Adler, T.A. Kopjtich, J.L. Katz, A.M. Chadderdon, J.R. Traynor, A.E. Jacobson, K.C. Rice. *Molecules*, **2020**, 25, 2640.

"Synthesis and biological evaluation of benzocyclooctene-based and indene-based anticancer agents that function as inhibitors of tubulin polymerization." **C. A. Herdman**, T. E. Strecker, R. P. Tanpure, Z. Chen, A. Winters, J. Gerberich, L. Liu, E. Hamel, R. P. Mason, D. J. Chaplin, M. L. Trawick, K. G. Pinney. *MedChemComm*, **2016**, 7, 2418-2427.

"Structural Interrogation of Benzosuberene-based Inhibitors of Tubulin Polymerization." **C. A. Herdman**, L. Devkota, C. M. Lin, H. Niu, T. E. Strecker, R. Lopez, L. Liu, C. S. George, R. P. Tanpure, E. Hamel, D. J. Chaplin, R. P. Mason, M. L. Trawick, K. G. Pinney. *Bioorganic and Medicinal Chemistry*, **2015**, 23, 7497-7520. doi: 10.1016/j.bmc.2015.10.012

"Synthesis of Structurally Diverse Benzosuberene Analogues and their Biological Evaluation as Anti-cancer Agents." R. P. Tanpure, C. S. George, T. E. Strecker, L. Devkota, J. K. Tidmore, C. M. Lin, **C. A. Herdman**, M. T. MacDonough, M. Sriram, D. J. Chaplin, M. L. Trawick, K. G. Pinney, *Bioorganic and Medicinal Chemistry*, **2013**, 21, 8019-8032. doi: 10.1016/j.bmc.2013.08.035

"Oxidative Mechanisms for the Biotransformation of 1-Methyl-1,6-dihydropyridine-2-carbaldoxime to Pralidoxime Chloride." F. A. Khan, A. J. Campbell, B. Hoyt, **C. Herdman**, T. Ku, S. Thangavelu, R. K. Gordon, *Life Sciences*, **2011**, 911-917. doi: 10.1016/j.lfs.2011.09.019

"Pro-2-PAM Therapy for Central and Peripheral Cholinesterases." J. C. DeMar, E D. Clarkson, R. H. Ratcliffe, A. J. Campbell, S. G. Thangavelu, **C. A. Herdman**, H. Leader, S. M. Schulz, E. Marek, M. A. Medynets, T. C. Ku, S. A. Evans, F. A. Khan, R. R. Owens, M. P. Nambiar, R. K. Gordon. *Chemico-Biological Interactions*, **2010**, 191-198. doi: 10.1016/j.cbi.2010.02.015

PATENT

"Benzocyclooctene-based and indene-based anticancer agents." K.G. Pinney, **C.A. Herdman**, R.P. Tanpure, Z. Chen. U.S. Patent Appl. Publ. **2018**, US 20180002355 A1 20180104.

PRESENTATIONS

"DEA Regulatory and Trends Update." **C.A. Herdman**, Presented at CLIC Technical Training Seminar, Minneapolis, Minnesota, 2024.

"Design and Illicit Manufacture of Synthetic Drugs." **C.A. Herdman**, Presented at 2024 CPDD Annual Scientific Meeting, Montreal, Canada, 2024.

"New Psychoactive Substances Emerging in Poly-Substance Combinations in the United States." W.J. Heuett, **C.A. Herdman**, D.P. Pressley, L.L. Wong, T.L. Boos. Presented at IX International Conference on Novel Psychoactive Substances, Panama City, Panama 2022.

"Novel Psychoactive Substances Current Trends and Recent DEA Controls." **C.A. Herdman**, W.J. Heuett, M.L. Van Linn, L.L. Wong, T.L. Boos. Presented at CLIC Technical Training Seminar, Houston, TX, 2022.

"Emerging Non-Fentanyl-Related Synthetic Opioids in the United States." **C.A. Herdman**, M.L. Van Linn, W.J. Heuett, D.P. Pressley, L.L. Wong, T.L. Boos. Presented at VIII International Conference on Novel Psychoactive Substances, Virtual, 2021.

"Identifying NPS Patterns in the United States." W. Heuett, **C. Herdman**, D. Pressley, L. Wong, T. Boos. Presented at VII International Conference on Novel Psychoactive Substances, Vienna, Austria and Virtual, 2020.

"Synthesis of enantiopure 10-noraltrexone as potential TLR-4 antagonist and opioid receptor ligand." **C. Herdman**, A. Jacobson, K. Rice. Poster Presentation at 254th ACS national Meeting and Exposition, Washington, D.C., 2017.

“Synthesis of enantiopure 10-nornaltrexone as potential TLR-4 antagonist and opioid receptor ligand.” **C. Herdman**, A. Jacobson, K. Rice. Poster Presentation at Gordon Research Conference – Heterocyclic Compounds, Newport, RI., 2017.

“Design and synthesis of benzosuberene analogues as potential vascular disrupting agents.” **C.A. Herdman**, L. Devkota, C.M. Lin, C.S. George, R. Tanpure, T.E. Strecker, D.J. Chaplin, M.L. Trawick, K.G. Pinney. Poster Presentation 69th Southwest Regional Meeting of the American Chemical Society, Waco, TX., 2013.

PREVIOUS EXPERT TESTIMONY

Case Name	District	Case Number	Year
US v Broussard	District of Minnesota	0:19-cr-00101	2022
US v Frazer	Southern District of New York	7:22-cr-00665	2023
US v Aziz	Southern District of New York	7:21-cr-00113	2024

AWARDS AND AFFILIATIONS

2020-2022; 2023-Present	The International Society for the Study of Emerging Drugs
2016-Present	Affiliate of the American Association for the Advancement of Science
2006-Present	Affiliate of the American Chemical Society
January 2013	Outstanding Teaching Assistant Nomination, Baylor University
August 2012	Extraordinary Teaching Assistant Award; Baylor Department of Chemistry and Biochemistry